ELECTROMAGNETIC BANDGAP STRUCTURES

BACKGROUND

[0001] The present disclosure relates generally to wireless devices and, more particularly, to radio frequency (RF) devices that include a light emitting diode (LED) display or a liquid crystal display (LCD) with a metallic back plate in parallel with a single or multiple system metallic support plates.

[0002] This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

[0003] Electronic devices, such as cellular phones and laptops, often include transceivers to facilitate wireless communication of data, such as by either transmitting or receiving wireless data signals, with other electronic devices. These data signals are typically communicated over a network channel on a frequency band to and from one or more wireless devices. By way of example, one electronic device may transmit data signals to another electronic device over a channel of a particular Wi-Fi frequency band (e.g., 2.4 Gigahertz (GHz) or 5 GHz) or a cellular frequency band (e.g. 0.6 GHz to 3 GHz).

[0004] Electronic devices may include an electronic display, such as a light emitting diode (LED) display, an organic light emitting diode (OLED) display, or a liquid crystal display (LCD), to present visual information. For example, an LED display includes multiple pixels, each made up of an array of LEDs. The display architecture may include a display substrate stacked on one or more metallic display plates separated by an air gap. The display plates may include material used to facilitate displaying images by the light emitted from the LEDs. Briefly, integrating the display in a device, such as by stacking the display substrate on the metallic support plate(s) in parallel, may generate a transmission line effect due to the air gap between the conductive metallic support plates. The display substrate may include display circuits, multiple data lines (e.g., thousands of data lines communicating data between components on the display plate), and a glass substrate. In some display substrates, the various metal data lines may be located close to each other, thereby forming a plate-like structure. As such, and similar to the LED parallel support plates, a transmission line effect may be created between the plate formed by the data lines and the support plate.

[0005] The "transmission line" may carry noise by allowing surface current to flow from one side of the device (e.g., on the display substrate) from a noise generator, which may be referred to as an "aggressor," to the other side of the device to a component that may be adversely effected by the noise, which may be referred to as the "victim." The noise may flow back-and-forth between the aggressor and the victim. In particular, the aggressor may include components of the device that are used for device operations not directly associated with an intended wireless communication. For example, the aggressor may generally include display multiplexer and de-multiplexer circuits, diodes, microprocessors, chips, and the like.

[0006] On the other hand, the victim may include device components that are impacted by the aggressor, such as components directly used for wireless communication operations. The victim may include one or more antennas (e.g., Long-Term Evolution (LTE) antenna, global positioning system (GPS) antenna, and/or Wi-Fi antenna), low noise amplifier (LNA), power amplifier (PA), etc. Unintended signals, voltage, or surface current causing noise may travel from the aggressor to the victim via the display architecture, thereby impacting the intended wireless communication signals. In some implementations, the aggressor may also include noise or surface current generated by a transmitted radio frequency (RF) signal. For example, the noise occurring on the same frequency band as the transmitted RF signal may couple to nonlinear display components or circuitry on the display substrate (e.g. multiplexer circuit), which may result in intermodulation of the noise. The intermodulated noise may occur on a receiver frequency band (rather than the transmitter frequency band) and may be coupled to the receiver through reflections. As such, the intermodulated noise may interfere with a victim, such as the receiver of the RF device.

SUMMARY

[0007] A summary of certain embodiments disclosed herein is set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of these certain embodiments and that these aspects are not intended to limit the scope of this disclosure. Indeed, this disclosure may encompass a variety of aspects that may not be set forth below.

[0008] The present disclosure generally relates to mitigating or stopping noise or surface current from flowing from one portion of an electrical device to another portion of the electrical device using one or more electromagnetic band gap structures (EBGs). In some embodiments, the electromagnetic band gap structures may be etched into or mounted on and across a support plate (e.g., mid-support plate) to create a stopband for surface current flowing across (e.g., back-and-forth) on the support plate. Moreover, in some embodiments, the etched EBG structures may be tuned to reduce or minimize surface current flow or other noise occurring at a particular frequency.

[0009] For example, the shape of the EBG structures etched across the support plate may be tuned to avert the noise at particular frequencies. The EBG shapes may be characterized into two categories: narrowband and broadband EBG shapes. Narrowband EBG shapes may be described by their simple structure and may be easily manufactured or etched inside a plate. By way of example, a rectangular slot shape design may be considered a narrowband EBG. Broadband EBG shapes may include multi-edged shapes, such as a bow-tie shaped slot, which may be used to tune for a range of frequencies using the length of the multiple edges (e.g., bow edge length and bow height edge length).

[0010] Various refinements of the features noted above may exist in relation to various aspects of the present disclosure. Further features may also be incorporated in these various aspects as well. These refinements and additional features may exist individually or in any combination.